OLEOPHILIC SEPARATION OF BITUMEN IN WATER EMULSION PRODUCTS FROM IN-SITU THERMAL RECOVERY OF BITUMEN AND HEAVY OIL.

FINAL REPORT

BY

KRUYER RESEARCH AND DEVELOPMENT LTD.

Work on this project was conducted under the auspices of the Canada Centre for Mineral and Energy Technology, Energy, Mines and Resources, Canada.

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MICROMEDIA

ABSTRACT

On October 26, 1982 a contract was issued by Supply and Services Canada on behalf of the Department of Energy, Mines and Resources to Kruyer Research & Development Ltd for conducting a study to evaluate oleophilic separation of bitumen/water emulsions with the emulsions to be supplied by the Department of Energy, Mines and Resources. Apparatus modifications, debugging and preliminary test work was done by Kruyer Research & Development Ltd in their Edmonton laboratories but the work terminated when the Department of Energy Mines and Resources was not able to obtain the required emulsions. An amended contract was then issued by Supply and Services Canada to pay for the work that had been done till then. This report describes the work that was done.

INTRODUCTION

On June 12, 1981 the author gave a lecture to the staff of the CAN MET laboratories and invited guests of the Department of Energy, Mines and Resources in Ottawa to introduce the concepts of Oleophilic Separation technology by the Kruyer Process. Subsequent discussions and meetings with staff of CAN MET resulted in a unsolicited proposal for funding a test program to confirm the merit of this technology for separating emulsions produced in-situ from deep tar sand and heavy oil deposits. This proposal resulted in a $ 75,259. fixed price contract that became effective on October 26, 1982.

The proposed study was for a pilot plant program for oleophilic separation of dispersed bitumen-in-water emulsions on a 100 to 1000 gallon per day scale in the Kruyer Research & Development Ltd Edmonton laboratory and pilot plant. It was to include:

1. Removal of the repulsive forces that keep bitumen particles suspended in the emulsion. It was proposed that a chemical demulsifier be used to achieve that step of the process but without a hydrocarbon diluent as currently practiced in other conventional emulsion breaking processes.

2. Use of a drum agglomerator to bring the bitumen particles together to form a continuous undiluted bitumen phase and a continuous water phase by agglomeration. The Kruyer proprietary agglomeration to be used had been tested with various feedstocks before and had been found to work very effectively for bitumen emulsions. The process employs a tumbler containing oleophilic free bodies. Dispersed bitumen particles collect on the surfaces of these free bodies to form bitumen layers that build up, but the shear forces in the tumbler cause these free bodies to shed bitumen from their surfaces in the form of droplets or streamers, much larger than the original bitumen particles of the emulsion. Accumulation and shedding of bitumen is a continuous process that very effectively and efficiently separates the emulsion into clean water and bitumen droplets or streamers.

3. Use of an oleophilic sieve belt conveyor to separate the bitumen phase from the water phase by passing the agglomerated suspension through the oleophilic sieve. During oleophilic sieving the water and hydrophilic solids pass through the sieve apertures while the bitumen is captured by the oleophilic sieve surfaces. The belt conveyor sieve carries the bitumen to a recovery zone for bitumen removal.

It was proposed that the program would make use of suitable equipment to feed emulsion from 45 gallon drums in which they were supplied. These drums were to be mounted on a rotating tiltable frame, which mixed the drum contents and spilled it into

a pump box from where the mixture or emulsion was to be pumped to the agglomerator. Oleophilic spheres in the agglomerator were to serve as free bodies to increase the bitumen particle size after which the agglomerated mixture was to be conveyed to the oleophilic sieve conveyor belt for separation.

It was anticipated that the program would require three months of work by the staff of the Kruyer Research & Development pilot plant. One month would be required to modify the pilot plant. Another month would be required to conduct debugging runs to assure proper mechanical operation of the equipment, to establish a suitable demulsifier and to determine the amounts of such demulsifier needed. Two weeks would be required to analyse the samples and to write the research report.

EXECUTION

Work commenced on the contract on October 26, 1982 upon receipt of a telegram from Supply and Services Canada giving approval to proceed with the work.

The first month and a half of work involved overhaul of the pilot plant equipment and modification of this equipment to process emulsions.

The pilot plant had just been used for separating mined tar sands and the required modifications included:

1. Overhaul of several slurry pumps to make them suitable for pumping agglomerated emulsions.

2. Overhaul of the hydraulic equipment required to power the agglomerator and the belt separator and to power the equipment to be used for dispensing the feedstock into the pump box.

3. Cleaning of the agglomerator and preparing it for emulsions separation.

4. Overhaul of the belt separator and modifications of this equipment to separate emulsions.

5. Fabrication of an oleophilic sieve conveyor belt suitable for separating emulsions. This conveyor belt was made from monofilament strands with 1/16 inch apertures between them (much smaller than the 3/16 inch apertures used for separating mined tar sands). This belt was mounted onto the oleophilic separator and was tested with mixtures of water and bitumen to assure that it worked well mechanically and was effective for separating mixtures of water and bitumen.

6. Overhaul and modification of equipment to dispense emulsions. This equipment consisted of two cages on weighing scales that would accept 45 gallon drums of emulsion and tumble these in a tiltable frame to mix these emulsions with an emulsion breaker and then to spill the drum contents into a pump box for transfer to the agglomerator. This equipment had been used previously for dispensing tar sand tailings to the pilot plant.

7. Hook up of a data logger to the modified equipment to measure pilot plant process temperatures and the weights of the feedstock supply cages and of the tailings receptacles and of the bitumen product receptacles. Programming of the data logger to provide a print of the data every 5 minutes in engineering units suitable for computing mass balances during the pilot plant tests planned.

The equipment used for this test program represented well developed technology that had been used in previous research programs, also with bitumen in water emulsions, but which was to be applied to the emulsions to be supplied by the Department of Energy, Mines

and Resources, and for evaluation as to the merit of more comprehensive work on emulsion separation by the Kruyer Process in conjunction with in-situ steam drive heavy oil and bitumen production plants.

Laboratory test work was conducted thereafter with a number of proprietary emulsion breakers to establish routine procedures for mixing these emulsion breakers with emulsion feedstock during the test program. These emulsions, supplied by vendors were also compared on a laboratory scale with bivalent salt emulsion breakers, such as calcium chloride, calcium sulphase and calcium hydroxide. It was found that the emulsion breakers supplied by the vendors were soluble in oil and were a liquid that could be more conveniently mixed with the emulsions in the pilot plant. However, the test work with emulsion breakers was preliminary in nature and was stopped when it became apparent that the test program would have to be aborted because of the unavailability of emulsion feedstock for the pilot plant.

CONCLUSION

When it became known that no emulsions could be obtained for testing in the pilot plant during the contract period, the test work was stopped and the staff of the pilot plant was dismissed for lack of funds. No new technology was developed.

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